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ABSTRACT

This report presents comments from working groups in the electronics, health services, and construction industries regarding what occupational competencies are and will be needed by current and future employees. It is intended for use by state and local advisers and administrators to evaluate the relevance and quality of vocational-technical education. Information on the three industries is provided in three sections. Each section covers these topics: projected number of employees needed over the next 5-10 years, skill requirements, equipment, facilities, methods and procedures, and resources and training materials developed by the industries. Section II on health services addresses these areas separately for health care employees and dental employees. Each section also includes other information that would be helpful, additional comments, and recommendations as to what needs to be done. An appendix provides charts on health care occupations growth and growth and educational demands of other occupations. Names and addresses of members of the occupational competencies working groups are provided. (YLB)

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Occupational Competencies

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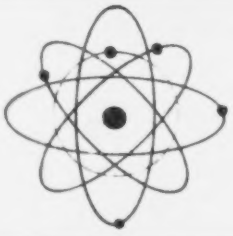

Electronics

Health Services

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National Council on Vocational Education

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Occupational Competencies Report

The Electronics, Health Service and Construction Industries as Surveyed by the Trade Associations

National Council on Vocational Education
April 1989

Preface

Staff and members of the National Council of Vocational Education appreciate the support and assistance of the individuals who served on the three working groups on occupational competencies. Their knowledge and insight in the electronics, health services and construction industries made this report possible. Also appreciated is the assistance of Madeleine Hemmings, who helped arrange the initial meeting of the trade associations.

The inclusion of occupational competency working groups in the Carl Perkins Act of 1984 provided the valuable opportunity for Council members and staff to meet with industry representatives to discuss current and future education and employment needs. Members of Congress are to be commended for their wisdom in authorizing the Council to pursue this information. This report is intended for use by state and local advisers and administrators to evaluate the relevance and quality of vocational-technical education.

The National Council on Vocational Education continues to support the important, mutually beneficial relationship between business/industry/labor and vocational-technical education. Both secondary and postsecondary programs benefit from close, working relationships with business, industry and labor. At the same time, vocational-technical schools provide an introduction to career occupations and expose students to the possibilities of career laddering. While a person may be educated as a dental assistant, and that can be the end goal, part of the role of vocational-technical education is to expose the individual to what is ahead, what is available in career advancement and enhancement.

Members and staff of the Council welcome comments and suggestions on industries that should be included in the next working groups to be formed.

With these cooperative efforts, America will have the best and most effective vocational-technical education system that will help support the life-long learning its workforce needs.

Committee Chairpersons,
Mary S. Pyle
Robert Case II

Foreword

National wealth in today's economic world is measured not only in gold, oil, minerals and other natural resources but in people and their productivity. Europe and Japan after World War II proved the value of human capital with their knowledge, skills and organizations. Today, this nation's income-generating assets are the knowledge and skills of its workers.

In this report, we are attempting to help vocational-technical educators and administrators, business, industry and labor protect those assets by looking at what will be required of workers in the next decade – the basic skills needed to enter training, the skills needed when training is completed and those that are needed for career laddering. We are trying to offer some basic insights into the changing requirements of employers and the competency skills that workers must possess to fulfill those needs.

While predicting workplace needs in the future is an uncertain science, there are many serious indicators that can be read accurately. The risks of predicting the future with accuracy are minimal compared to the disadvantages of entering the next decade and beyond without a planned strategy to educate and recruit our next generation of workers.

To begin our look into occupational competencies, we chose three industries that have been identified as some of the fastest growing and most rapidly changing. The health care industry is expanding at an enormous rate, and additional allied occupations are being added. Technology is developing rapidly in the health care field, and innovative methods of treatment and diagnostics are being introduced. The electronics industry, a relatively young industry, is booming as consumer and business products are developed almost daily. The construction industry is continuing to employ thousands of workers and to reach out into new fields as technology is developed that requires new, sophisticated knowledge and skills.

At the same time that these businesses and industries are growing rapidly, industries that in the past have relied on flexible, lower-paid workers, are beginning to find that such workers are in shorter supply. The population and the workforce are growing more slowly than at any time since the 1930s, and the pool of young workers entering the labor market is beginning to shrink. At the same time, the fastest growing jobs are in professional, technical and sales fields, and these jobs require the highest education and skill levels. Of the

fastest-growing job categories all but one – service occupations – require more than the median level of education for all jobs. Of those growing more slowly than average, not one requires more than the median education.

A major study, "Workforce 2000, Work and Workers for the 21st Century," conducted jointly by the Hudson Institute and the Department of Labor, shows that ranking jobs according to skills, rather than education, illustrates the rising requirements. "*When jobs are given numerical ratings according to the math, language and reasoning skills they require, only 27 percent of all new jobs fall into the lowest two skill categories, while 40 percent of current jobs require these limited skills. By contrast, 41 percent of new jobs are in the three highest skill groups, compared to only 24 percent of current jobs.*"

The implications? More workers – those new to the workforce as well as those retraining or adding skills – will need more education, and much of the burden will fall increasingly to vocational-technical institutions.

The rising educational and skill requirements are striking as reported in the "Workforce 2000" report: "*Of all the new jobs that will be created over the 1984-2000 period, more than half will require some education beyond high school.... The median years of education required by the new jobs created between 1984 and 2000 will be 13.5, compared to 12.8 for the current workforce....*

"*...Education levels, of course, are only a rough proxy for the skills required for employment. But more detailed analysis of the language, math and reasoning skills required for various jobs reinforces the conclusion that the skill mix of the U.S. economy will rise substantially between now and the end of the century ...*

"*...When skill requirements in language, reasoning, and mathematics are averaged, only 4 percent of the new jobs can be filled by individuals with the lowest levels of skills, compared to 9 percent of jobs requiring such low skills today. At the other end of the scale, 41 percent of the new jobs will require skills ranked in one of the top three categories, compared with only 24 percent that require such proficiency at present.*

"*Although the overall pattern of job growth is weighted toward higher-skilled occupations, very large numbers of jobs will be created in some medium to low-skilled fields. In absolute numbers, the biggest job creation categories will be service occupations, administrative support, and marketing and sales, which together account for half of the net new jobs that will be created....*"

Put simply, students must go to school longer, study more, and pass more difficult tests covering more advanced subject matter, and vocational technical programs will not be warehouses for students who perform poorly in academic subjects or for diplomas that register nothing more than years of school attendance. Vocational-technical education will be the key to preserving our largest natural resource – a productive workforce – and thus in keeping our nation competitive internationally.

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Background

Part D of the Carl Perkins Act of 1984 mandates the National Council on Vocational Education to establish working groups to study occupational competencies. The purpose of these groups is to provide the Secretary of Education, the President, Members of Congress, and state and local education administrators and advisers with current information on the types and levels of occupational competencies necessary for entry and sustained productive employment in given jobs or industries.

The information requested from members of the working groups includes levels and skills required, equipment, methods and facilities needed for the occupation.

The law gives the Council the authority to establish working groups for the occupations Council members and staff consider important or necessary. Members of the working groups are appointed by the Council on the advice of national trade and professional associations and labor organizations. Working group members have specific knowledge in the technology and practice of the occupations they represent. The results and recommendations of the working groups are to be disseminated to each State Council on Vocational Education and other appropriate state agencies.

Also, the Perkins Act gives states a mandate to establish technical committees, which correlates with the occupational competency mandate of the National Council. While the National Council looks at the overall trends, technical committees established at the state level look at curriculum and specific competencies taught. The role of the technical committees is to advise the state council and the state board on the development of model curricula to address state labor market needs.

Technical committees develop an inventory of skills for use by the state board to define state-of-the-art model curricula. The purpose of the inventory is to provide the type and level of knowledge and skills needed for entry, retention and advancement in occupational areas taught in the state. The state board establishes the procedures for membership, operation and duration of such committees consistent with the purposes of the Perkins Act. The membership consists of representatives from employers, trade or professional organizations and organized labor.

On February 4, 1987, members and staff of the National Council on Vocational Education, under the leadership of Mary Pyle, met with 13 national trade association leaders and representatives of labor organizations to establish a working relationship in order to project future occupational competencies for their employment areas. Everyone who attended expressed a strong interest in establishing a working partnership with the National Council, and the feasibility of establishing such working groups was discussed.

The Council staff has coordinated the efforts of the working groups with the state technical committees. On May 5, 1987, the National Council co-sponsored with the East Central Curriculum Coordinating Center (ECCCC) a conference in Washington, D.C., to examine the establishment of technical committees. Much variation in how technical committees were being implemented was found. A recent follow-up survey published by the ECCCC reports current technical committee efforts. After looking at these findings, members of the Council believe that technical committees should draw the majority of their members from business, industry and labor.

Process and Results

On October 20 and 21, 1987, members and staff of the National Council met with representatives of national trade associations, labor, business and industry to discuss employee competencies. Working groups in the electronics, health services and construction industries were established to determine what occupational competencies are and will be needed by current and future employees. The three industries were selected by the Council based on projected employment needs and information from trade associations and educators.

The topics discussed included projected number of employees needed over the next 5 to 10 years, skill requirements, equipment, facilities, methods and procedures, and resources and training materials developed by the industries. Each of the three working groups met separately but provided similar general recommendations. They concluded that potential employees should have:

- basic skills in math, science, communication and use of computers
- strong work ethics
- occupational skills related to entrance into the industry

The working groups concluded that the educational system should be able to develop these competencies in order to help the United States be competitive in trade. If employees have these basic, transferable skills, then business, industry and labor can provide the specialized education and training. In particular, smaller businesses need to be able to rely on the education system – both secondary and postsecondary – to provide the basic knowledge and skills for the work force. Smaller businesses create most of the new jobs in the United States, but they do not have the resources to provide education and retraining. The smaller

businesses also provide experience for recent vocational-technical education graduates who often later become employees of larger companies.

Members of the working groups stated that mutually beneficial, cooperative efforts between business/industry/labor and education should be encouraged. Business and industry need assistance retraining current employees. Customized training established by a number of states through vocational-technical education was commended.

Members of the working groups also encouraged direct accountability of cooperative business/industry/labor and vocational-technical education efforts, such as through a signed agreement, and the programs also should include updating the knowledge and skills of instructors.

Members of all three working groups stressed the increasing need for competent employees. As an example, the owner of a Virginia electronics company stated that he needed five qualified technicians but he has not been able to find anyone in the United States who had the skills or was willing to relocate. He is, therefore, investigating the possibility of hiring workers from Japan or some other foreign country. This example of the shortage of skilled workers is not an isolated case. The average age of journeymen in the construction industry is 50 to 58. When these workers retire, there are few new entrants in the work force to fill the gap.

Providing a flexible work force that can make decisions, adapt to changes and practice quality control is a big job. It will require the commitment and investment of private and public sectors. Information obtained from the National Council's work with trade associations, labor, business and industry will be used by the vocational-technical education system to be more responsive to current and future needs.

Members of the working groups in the electronics, health and construction trades were asked to complete a discussion form covering the areas stated in the Carl Perkins Vocational Education Act. The following report summarizes the comments from those discussion forms.

Section I: Electronics

Number of Employees Needed the Next 5 to 10 Years

The need for electronic technicians is expected to grow 51 percent by 1995, bringing a total of 607,000 technicians to the workforce. Between 40,000 and 50,000 new technicians will be needed in the next 5 years just to replace retirees and others leaving the industry. Electronic technicians will be needed in a variety of areas, including appliance, auto, industrial and consumer electronics.

Skill Requirements

Occupations increasing in importance within the electronics industry are telecommunications, service management, field engineering and all phases of microprocessors, from operation to repair. The fastest growing consumer electronics occupation is that of electronic technician; electronics occupations relating to autos and appliances also are increasing in importance.

Occupational competencies required for jobs in the electronics industry are established by related industries working closely together and through the cooperative efforts among electronic manufacturers, national electronic service dealers and educators from secondary and postsecondary institutions. All come together at various times under the auspices of educational consultants and service management personnel. Competencies required for jobs in electronics are identified through testing by the Certified Electrical Technician Program, the National Electronics Sales and Dealers Association and various work programs.

There currently exists an alarming shortage of electronic technicians that will continue well into the 1990s. We must rely on vocational-technical education to train young adults for promising careers in electronics.

Don Hatton, Staff Vice President, Product Services
Electronic Industries Association Consumer Electronics Group

The working group concluded that because electronics is becoming such a broad area, specialization will be necessary in the next 5 to 10 years. Employees will need specialized training in digital and microprocessor

technology, with an emphasis on large-scale integration. They will need to know how microprocessors work and how to troubleshoot the circuits where the microprocessors are used. Employees also will need to use and understand complex and automated test equipment and high technology mechanical assemblies. They should be able to use computers for data retrieval, problem solving and business management. Knowledge of micro-soldering techniques will be necessary. Finally, specialists will be needed in the areas of electromechanical robotics and communications.

Academic and basic skills important for the employees in the electronics industry include communication, in particular the ability to explain how new complex circuits operate; science, especially physics; and math. Basic math is necessary for all levels; algebra and trigonometry are required for more advanced technicians and employees interested in career advancement. Other skills include the operation of calculators and computers capable of handling engineering formulas. In addition, electronics employees should be familiar with basic technical vocabulary in order to understand technical directions and training materials and to write reports and follow instructions.

Equipment

Employees need to know how to use an oscilloscope, a digital multivolt meter and video generators, as well as other related test equipment. More information about equipment can be found in the *Recommended Test Equipment List* published by the Electronics Industries Association, 2001 Eye Street, N.W., Washington, D.C. 20006

Although both secondary and postsecondary students should be trained to use the same equipment, many postsecondary programs stress more sophisticated and intense use of advanced equipment. Students need to learn to use basic test equipment (e.g., oscilloscope, digital multivolt meter (DVM), video generator and signal generator) to troubleshoot new, complex equipment. In addition, they should have hands-on experience repairing and installing consumer equipment. On-the-job training typically is based on local industry needs at a particular time. Cooperative education programs and partnerships with business and industry can help reduce the high cost of frequently replacing equipment as it becomes obsolete or outdated; however, it is important for students to learn basic, transferable skills that can be used even when equipment changes.

The electronics industry trains personnel to use Computer Aided Instruction. New technicians are taught the correct use of all test equipment, such as isolation transformers, signal generators (audio, video, RF) and oscilloscopes. New employees also are trained to use equipment listed in the *Recommended Test Equipment List*.

Computer Aided Instruction (CAI) will be used increasingly in the next 5 to 10 years, as well as more sophisticated, compact and automated test and measurement equipment, including

logic analyzers, logic probes and digital measurement apparatus. Consumer products also will change drastically over the next 5 years. Right now new ideas are being developed with industrial equipment that will be used in consumer products. For example, home security computers and autos are changing rapidly.

In just the last five years alone the electronics industry has seen a proliferation of new products and technological advancements greater than that of almost any other industry. With new products and technologies comes the increasing need for qualified electronic technicians to support these products.

James L. Teeters, Sr., CET/CEM
Vice President, The Service Group
4815 Virginia Beach Blvd.,
Virginia Beach, VA 23462

Facilities

Vocational-technical teaching facilities need to be equipped with state-of-the-art test equipment and products and an adequate supply of current technical library references, including textbooks, workbooks and technical training tapes. Modern audiovisual equipment and teacher resource materials also should be available. Both old and new equipment should be made available to vocational-technical students so they can learn troubleshooting methods on any equipment they might later meet on the job.

Methods and Procedures

Changes are occurring rapidly in methods and procedures in the electronics industry. The pressure in the next 5 to 10 years will be to teach more materials in less time to more people than ever before. To cope with the demand, stronger emphasis must be placed on independent study modules such as VCR training media, computer on-line forums, enhanced industry training (by both manufacturers and associations) and field workshops. To meet the needs of students and retraining employees, manufacturers will be called on to write clearer service manuals explaining new circuits. In addition, students and retraining employees will need extensive training in the use of precision low-wattage soldering techniques and handling of electrostatic devices.

The working group suggested that one way the heavy teaching demands can be met is for manufacturers themselves to train vocational-technical instructors, who then can teach students in local areas.

Industry Developed Resources and Training Materials/Systems

Special training programs have been developed in all areas of electronics. Examples are available from the Electronic Industries Association Consumer Electronics Group, 2001 Eye Street, N.W., Washington, D.C. 20006, (202) 457-4919. Also, companies such as JCV, Zenith and Sony can be contacted

for examples of their special training programs.

Other Information That Would Be Helpful

The working group expressed a concern that, in general, vocational-technical education needs to respond to industries' growing needs with revamped educational programs. Increasing amounts of time are needed to train future and present employees in the basics of electronics. Because of the large volume of material to be taught in the limited time allowed, vocational education alone cannot meet this intense training demand. One solution may be to grant vocational-technical education courses as credit toward academic requirements. For example, the math and science necessary for a job in the electronics industry could fulfill some of the academic requirements needed for a diploma or a degree. Further discussion is needed between secondary and postsecondary schools to eliminate redundancy of materials taught and expedite training goals.

Members of the working group also suggested that manufacturers should open their training schools to vocational-technical instructors. Because manufacturers are under heavy demands to train current employees on newly introduced equipment, there rarely is time left to teach courses on older equipment. If vocational-technical instructors were trained on equipment as it is introduced, they would have the background knowledge to instruct students on older and newer equipment, allowing students to learn the equipment even after manufacturers no longer teach about older equipment.

Another suggestion to improve vocational-technical education is to require institutions to follow-up on student placement within the industry. This information would help in developing future programs and in soliciting assistance from industry manufacturers and associations.

America was built by the thousands of technically trained workers required to support the products of a handful of engineers. Today, American industry must reinforce and expand upon its partnership with vocational-technical education if we are to recapture the industrial excellence we once enjoyed.

Don Hatton
Electronic Industries Association

Additional Comments

Electronics industry representatives said employers do not hire individuals just to train them. Industry looks for potential employees who understand principles used in the industry and can relate theories to practice.

Members of the working group stressed that academic and vocational education cannot be separated. Both are important, and academic and vocational teachers need to coordinate courses and material. Above all, teaching methods should motivate students to learn and retain information.

Partnerships between trade associations and vocational-technical education were suggested by members of the working group as a way to increase the efficiency of vocational-technical education. For example, trade associations can, on a statewide basis, train instructors and provide updating seminars. By teaching a few hundred instructors, thousands of students can be reached. Also, to stay current on trends and products, educators should be encouraged to attend national trade association meetings and business/industry conferences (e.g., the Service Dealers National Conference).

Working group members said two types of business/industry and education partnerships that have proven successful should be encouraged: customized training programs and management training programs. Investment in quality vocational-technical education results in important gains for business/industry, the community and the country, and the results should be used to encourage further progress.

In Summary, What Needs To Be Done

1. Young people need be recruited to fill jobs of retirees and those leaving the industry, and to meet the rapid growth in the industry.

2. Specialization is becoming necessary. More specialized training is needed, as well as training in the use of more complex and automated test equipment, electromechanical robotics and communications equipment.

3. Students need basic skills in communication, science and math.

4. Vocational-technical education programs need to teach students basic, transferable skills and the use of basic test equipment. In addition, students need hands-on experience repairing and installing electronics equipment and products.

5. Vocational-technical facilities need to be equipped with state-of-the-art test equipment and products. Facilities also should have an adequate supply of current technical library references, including textbooks, workbooks and technical training tapes plus modern audiovisual equipment and teacher resource materials.

6. Teaching materials for independent study need to be developed so more students can be taught in less time. Also, teaching methods need to motivate students to learn and retain information.

7. Vocational education programs need to be revamped to give academic credit for some vocational education courses, such as in math and science. Vocational education and academic programs need integration. Also, further discussion is necessary between secondary and postsecondary school programs to eliminate redundancy of materials taught and to expedite training goals.

8. School programs need to follow up on student job placements and then use that information to keep vocational-technical education programs responsive to industry needs.

9. The high cost of frequently replacing equipment as it becomes obsolete or outdated can be reduced by implementing cooperative programs and partnerships with business and industry.

10. Encouraging partnerships between trade associations and vocational-technical education facilities can increase the efficiency of such programs.

11. Educators should be encouraged to attend national trade association meetings and business and industry conferences.

12. Manufacturers should be encouraged to help in vocational training programs by opening their training schools to vocational-technical instructors.

13. Manufacturers need to write clearer service manuals and provide more new product training.

Section II: Health Service

Health Care Employees Needed the Next 5 to 10 Years

It is difficult to project accurately the number and types of health care employees that will be needed over the next decade because of the vast changes in technology, health care and ethics legislation, as well as current health care issues. For example, if substance abuse and HIV/AIDS testing become more prevalent, there will be a dramatic increase in the need for medical laboratory technologists. Even so, it is predicted that there will be an overall increase of 15 to 20 percent in the number of health care employees needed in the next decade. The Department of Labor predicts that most health care occupations will increase at a higher than average rate. (See charts from the Bureau of Labor Statistics in the Appendix.) The aging population will contribute to the demand, as will the increased number of survivors of severe accidents who need additional care.

The nursing profession in particular recently has been the focus throughout the health care field. A 1989 report published by the Department of Health and Human Services, Secretary's Commission on Nursing, discusses the shortage of registered nurses (RNs). In addition, three other 1989 reports also provide valuable information:

"Avoiding Crisis"
Allied Health Services
Institute of Medicine, National Academy Press
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

"Survey of Human Resources – 1988"
Department of Human Resources
Office of Legal and Regulatory Affairs
American Hospital Association
840 North Lake Shore Drive
Chicago, Illinois 60611

"Innovative Staffing Strategies"
Center for Nursing
American Hospital Association
840 North Lake Shore Drive
Chicago, Illinois 60611

Dentistry Employees Needed the Next 5 to 10 Years

Even at present there is a nationwide shortage of dental assistants and dental hygienists. While there is no current shortage of dental laboratory technicians, this occupation is important to the dental industry and is expected to grow.

In my position of representing the AFL-CIO, we strongly support all entry levels into nursing.

Karen S. Fennell RN, MS,
Government Relations Coordinator
American College of Nurse-Midwives

Skill Requirements

Numerous occupations are increasing in importance for the health care industry. With the expansion of high technologies in the diagnosis and treatment of human disease and injuries, occupations reported to be in general demand today are cardiovascular perfusionists; medical records administrators; occupational, physical and speech/hearing therapists; physician assistants; and technologists within the radiographic imaging field. Technicians (for ultrasound, MRI, CAT scan and so on) also are important, as are practitioners in sports medicine (fitness and nutrition), nurses (RNs and LPNs/LVNs), computer programmers and technicians, home health aides, geriatric care personnel, hospice workers and multiskilled practitioners. Home care is a rapidly expanding segment of the American health care system.

Additional information is available in the "IOM Study in Process," an article from *The Journal of the National Society of Allied Health,* Vol 1, No. 1.

The *Allied Health Education Directory*, published annually by the American Medical Association, contains the occupational competency statements for each of the 26 health occupations that fall within the purview of the Committee on Allied Health Education and Accreditation (CAHEA). Also, competencies are listed, field tested and approved based on information from advisory committees and health care professionals. Professional organizations establish standards for voluntary certification. Licensure requirements are set by state boards, a government process.

Two examples of how competency programs are developed are in the occupations of hospice and home health care workers and medical laboratory technologists. Through a grant from the Administration on Aging, a certification program for paraprofessionals in hospice and home care is being developed by the Foundation for Hospice and Homecare with the assistance of an advisory committee.

Also representative of the process is the Medical Laboratory Technologist (MLT) Essentials. Under that process, proposed new or revised standards receive the advice and consent from the major allied professions and/or medical specialty societies, the American Hospital Association, the CAHEA Panel of Consultants and Special Advisors, the AMA's Council on Medical Education and CAHEA.

Major changes in skill requirements for incoming health care employees in the next 5 to 10 years depend largely on factors outside the health care field, such as the world economy, environment, demographics, disease syndromes etc. If international markets begin to slump or suffer significant losses, the health care industry may feel

a recession. Should the economy within the United States and major world trade countries strengthen, then likely the pressure for increasingly sophisticated technology will continue to create demand for new types of allied health practitioners, which traditionally are generated from within related occupational fields, often through on-the-job training.

The demand for trained personnel will vary from community to community, and the educational system must be responsive.

Barbara Bloom Kreml, Director,
Department of Human Resources,
Office of Legal and Regulatory Affairs
American Hospital Association

Other health care employee attributes expected to be in demand in the next 5 to 10 years include multiskilled personnel and employees who can work with computers, robotics and complex technological equipment. The use of computers will increase substantially for quality control communications among physicians, nurses, pharmacists, physician assistants and others; and refinement of the diagnostic processes, including medical laboratory determinations. The percentage of lower skilled workers is expected to decrease.

According to a major study released in June 1987 by the Hudson Institute with the Department of Labor, "Workforce 2000, Work and Workers for the 21st Century," there will be rapid changes in the nature of the job market. In the health care field, the report says:

Throughout the postwar era, health care has been driven primarily by the desires of doctors and hospitals to improve the quality of medical care and treatment. Cost control and productivity gains have been of secondary importance. Until very recently, the emphasis has been on saving lives, rather than on saving money.

Attempts by the government, employers and large health care providers to control costs are likely to shift attention toward technologies and systems that improve efficiency and reduce expenses, without sacrificing the quality of care. When the large institutions that are increasingly in control of the health care industry begin to respond to these new incentives, radical improvements in productivity may be possible. For example:

- *The Self-diagnostic Health Clinic:* In the 1990s, patients of a modern HMO might receive sophisticated diagnosis and even some forms of treatment with limited intervention by doctors, nurses or clerical support personnel. A patient might enter a clinic and identify himself with an electronic card containing his complete computerized medical history and automatic billing information. After responding to a series of questions posed by a computer, he would submit to a series of self-administered, non-invasive tests (e.g., temperature, blood pressure, blood chemistry, urinanalysis and perhaps others based on cheap magnetic scanning devices). Finally, he might receive a preliminary diagnosis and be issued an unsigned prescription for medication. Only when this automated process was complete, would he see a nurse or a doctor. Routine treatments might be cheaper, less time-consuming, more private and more effective than those offered in today's clinics and doctors' offices.

- *The Automated Nursing Home:* Cooking, cleaning, personal care and other low-productivity tasks are the most costly aspects of nursing care. But the same technologies that promise to automate factories by the year 2000 – robotics, machine vision, artificial intelligence – have

application in this rapidly growing, labor-intensive service industry. Advanced robots capable of assisting patients with walking and feeding, cleaning floors, reading books or newspapers, or other tasks are only a few years away. These assistants will be thought of not as threatening or impersonal robots, but as personal tools capable of enhancing the diminished capabilities of nursing home residents.

Health service occupations require a variety of basic skills. Math, science and communication skills are needed in most health careers. Increasingly computer literacy or proficiency is required. Skills also are needed in ethics, safety and personal health, which already should be mastered by people entering health careers. Additional skills needed by mid-level employees are teaching, accounting and office management.

The curriculum for each health care occupation is so time consuming that little, if any, time is available for remedial work in basic skill areas. Communication skills are particularly important when dealing with clients, the public and other health professionals. Also, documentation on patients' records required of health professionals increasingly is subject to legal scrutiny.

Dentistry Skill Requirements

The Commission on Dental Accreditation of the American Dental Association validated its *Accreditation Standards* for dental assisting, dental hygiene and dental laboratory technology education in 1984 and 1985. The *Standards* identify competencies students must be trained to perform. The *Standards* were developed and validated by surveying all affected communities of interest. Copies of *Standards* are available from the American Dental Association, Commission of Dental Accreditation, Suite 1814, 211 E. Chicago Avenue, Chicago, Illinois 60611, (312) 280-6000.

Dental assistants and hygienists may need additional skills to (1) assist dentists in treating special needs patients and hospital patients; (2) operate, or assist with the operation of, laser equipment; (3) provide more nutritional counseling; (4) work in alternative settings; and (5) use computers for data management. Dental laboratory technicians may be using computer-aided drafting to design prosthetics.

The occupation of dental assistant requires a high school diploma or equivalent, oral and written communication skills and applied psychology. The occupation of dental hygienist requires a high school diploma or equivalent, science and communication skills and graduation from an accredited dental hygiene education program. The occupation of dental laboratory technician requires a high school diploma or equivalent, math, physics, chemistry, communication skills and business principles.

Health Care Equipment

Health care workers need to use various types of equipment, including computers and, in some instances, complex technological equipment such as nuclear medical resonance machines

(NMRs). Typically each occupational training program familiarizes its students with equipment necessary for their tasks.

Educational programs that involve clinical training should have written affiliation agreements with the clinical facilities specifying the roles and responsibilities of each entity. These agreements, reviewed annually, assure appropriate commitment to a given training or educational endeavor.

The same type of equipment is used to train secondary and postsecondary students, although equipment does vary depending on the occupation. In a cooperative training program in which hospitals generally supply equipment and materials, students should be allowed to use all equipment as long as they are supervised adequately.

Employees who specialize in more advanced techniques and procedures are trained by the employer to use the special equipment. New technologies and equipment are taught to current employees in inservice training sessions.

One of the critical needs facing vocational-technical educational facilities is funding to develop self-instructional resources that would give faculty and students more effective use of their time and promote higher retention of new knowledge and skills.

In the next 5 to 10 years, certain equipment will become more sophisticated and increase in use, including information retrieval of patient data, monitors of patient functioning and maintenance and computerized scans and diagnostic equipment. Also increasing will be the use of technology such as laser surgery and organ transplants. The annual publication of the AMA's *Allied Health Education Directory* is a helpful reference on changes and new equipment in the health care field.

Dental Equipment

Dental assistants and dental hygienists over the next 5 to 10 years will be using computers and laser equipment more often, equipment will be used more in alternative settings and preventive and maintenance procedures will be used increasingly. Dental laboratory technicians will use computers more frequently.

Dental assistants need to know how to use all equipment found in the dental operatory: sterilizing equipment, instruments, intra- and extra-oral radiography machines, processing equipment, emergency equipment and laboratory equipment (lathes, model trimmers, vibrators). Dental hygienists need to know how to use slow-speed handpieces, prophy jets and intra- and extra-oral radiography machines and processing equipment. Dental laboratory technicians need to be familiar with lathes, model trimmers, articulators, vibrators, ovens, casting devices, handpieces, soldering devices and electroplating machines.

Within the dental profession, dental assistants are trained to use advanced dental radiography equipment after they are employed, and dental hygienists are trained to use specialty equipment and instruments.

It should be noted that state and/or federal child labor laws may restrict the use of radiography equipment and other

dental-related hazardous materials by students under 18 years of age.

Health Care Facilities

Diversification of the hospital industry offers many alternatives to the traditional acute care setting: clinics, sports medicine facilities, rehabilitation centers, substance abuse clinics, home health care, etc. Still needed are more nursing homes to accommodate an increasing geriatric population; more home health and hospice agencies; more Health Maintenance Organizations (HMOs) and similar health care providers; more outpatient services, both medical and surgical; and more extended care facilities.

Many hospitals make equipment and learning laboratories available to affiliated educational programs for student use. While much of the health care vocational-technical education takes place on a postsecondary level, much of what is taught in community college health care courses could be mastered just as easily by selected high school students. Members of the working group expressed optimism that one day there will be curricula designed on an honors track for bright high school students who prefer vocational-technical education to begin their career preparation over the college prep model.

Dentistry Facilities

Dental hygiene education begins on the postsecondary level. The Commission on Dental Accreditation believes that dental assisting and dental laboratory technology education also should occur at the postsecondary level.

Cooperative education does not typically exist in dental auxiliary education programs; however, some students gain clinical experience off campus in fully equipped dental offices and clinics. Students do not receive remuneration for services they provide during their extramural clinical assignments.

In the dental area, *The Accreditation Standards* (*Standard 8. Facilities*) presents the facility specifications required of accredited dental assisting, dental hygiene and dental laboratory technology education programs. These standards were validated by industry representatives in 1984 and 1985.

Methods and Procedures

The look of health care is changing as the variety and use of high technology equipment in the industry is increasing, especially the use of computers. Also increasing is the emphasis on outpatient care, the delivery of services in alternative health care settings and managed care.

Another factor governing many health care methods and procedures is that health professionals in all occupations are being held personally accountable for their actions, especially with the increased number of malpractice suits being litigated.

In the nursing profession, there was a movement, now supplanted by other proposals, to require the Baccalaureate Degree in Nursing (BSN) as a minimum entry level, with the Associate Degree in Nursing (ADN) as a technician, and the

Registered Nurse and License Practical Nursing/License Vocational Nursing diplomas abolished. Had the movement prevailed, these changes would have had a great impact on the cost and reliability of health care, increasing the already severe shortage of health care workers.

In response, the American Medical Association has proposed the creation of a Registered Care Technician (RCT). The competencies proposed for this occupation are contained in the AMA's Nursing Commission Report. Essentially, the RCT would perform a level of duties and be required to fulfill competencies somewhere between the levels of an RN and an LPN/LVN.

At the same time, health care occupations are helping themselves provide some of the training materials and guides. For example, a curriculum has been developed for the rapidly growing Home Health Caring Council, a division of the Foundation for Hospice and Home Care. Copies of "Model Curriculum for the Training and Instruction of Homemaker-Home Health Aides" are available from the NHCC at 519 C Street, N.E., Station Park, Washington, D.C., 20002.

That curriculum will need to be responsive to the requirements of the Omnibus Budget Reconciliation Act of 1987 (OBRA), PL 100-203, which requires nursing assistants in long-term care facilities qualifying for Medicare and Medicaid funding (as many as 40 to 60 percent of nursing home residents come under these provisions) to be trained as a nurse's aide or nursing assistant following a competency program. Likewise, there is a requirement for regular inservice education, and there is a retraining requirement for anyone not working in the profession for a specified time limit.

Dentistry Resources

Within dentistry, curriculum guidelines have been developed for dental assistants through the American Association of Dental Schools, audio cassettes and workbooks through the American Dental Assistants Association, some computer-aided instruction and numerous reference textbooks and workbooks. Dental hygienists have developed programmed texts for instrumentation instruction, computer-assisted instruction and numerous textbooks. Dental laboratory technologists have developed the Fabrication Procedures Manual and the Videotape Library of Procedures.

Other Information That Would Be Helpful

Representatives of the health care industry anticipate an increased demand for biomedical engineers and computer scientists, both to maintain increasingly sophisticated equipment used in diagnosis and treatment and to conduct biomedical research. New technologies likely will be created or will evolve from present occupational roles into hybrid occupations. Diagnostic medical laboratory science likely will continue to change, with less reliance on technologists and more on technology, for example, the autoanalyzer. Advances in pharmacotherapeutics, laser technology and metallurgy are expected to have an impact on several occupations.

Because the health care industry is dynamic and not static, it is difficult to predict employment needs and trends for more than 3 or 4 years ahead. Changes in reimbursement, technology, legislation and regulation all affect the services available and, subsequently, personnel needs. Hospitals also are somewhat unique in that 80 percent of the workforce is female, and women today have many more career options than they did 10 years ago.

From an educational perspective, the greatest need facing health care vocational-technical education is to develop links among the different educational levels that recognize previous education and experience. With better coordination of programs, individuals could plan their careers better and make the most of financial and other resources.

Information on the employment of dental assistants, dental hygienists and dental laboratory technicians is available from:

National Association of Dental Laboratories
3801 Mount Vernon Avenue
Alexandria, Virginia 22305

American Dental Hygienists' Association
444 N. Michigan Avenue 34th Floor
Chicago, Illinois 60611

American Dental Assistants' Association
919 N. Michigan Ave., Suite 3400
Chicago, Illinois 60611

Additional Comments

During the working group meeting, several participants from the health industry made additional comments, including the reiterated point that potential employees need verbal and written communication skills, decision-making skills and interpersonal skills. A science-based education is especially important for technicians.

One representative suggested that through cooperative education the use of equipment in clinics can be taught effectively. This brought up the point that technicians who are qualified to use more than one machine are needed by the industry and that high-level technical skills are needed not just in hospitals but in clinics as well.

Several members of the working group stressed the importance of retraining and continuing education for health services employees. One way the industry can provide the training for the trainers is to bring in experts from the community and agencies.

Health care representatives expressed concern that fewer young people are choosing careers in the health industry. Working group members suggested that involving adolescents in the health services community and encouraging them to accept responsibility might lead them to consider it as a career.

In Summary, What Needs To Be Done

1. Students entering health care vocational-technical training need a variety of basic skills including math, science, and verbal and written communication. Increasingly computer literacy or proficiency is required. Skills also are needed in ethics, decision-making, interpersonal relations, safety and personal health.

Additional skills needed by mid-level employees are teaching, accounting and office management. Some occupations also may require applied psychology and business principles.

2. Educational programs that involve clinical training should have written affiliation agreements with the clinical facilities specifying the roles and responsibilities of each entity to assure appropriate commitment to a given training or educational endeavor.

3. Self-instructional resources need to be developed to provide faculty and students with more effective use of their time and to promote higher retention of new knowledge and skills.

4. The health care field in general is in need of more facilities and programs in the following areas: nursing homes and health and hospice agencies; Health Maintenance Organizations and similar health care providers; outpatient services, both medical and surgical; and extended care facilities. Employees will be needed to staff these facilities and programs.

5. An honors track needs to be developed for bright high school students who prefer vocational-technical education to begin their career preparation over the college prep model.

6. The movements in the health care industry need to be followed closely to make significant changes in competency requirements, such as requiring the Baccalaureate Degree in Nursing as a minimum level and abolishing the Registered Nurse and License Practical Nurse/License Vocational Nursing diplomas, or the one to establish a Registered Care Technician. These proposals could change significantly the cost of health care and cost and training time.

7. Links among the different educational levels need to be developed to recognize previous education and experience.

8. The use of equipment in clinic settings needs to be incorporated in cooperative education programs.

9. Technicians need to be encouraged to qualify in the use of more than one machine.

10. The importance of retraining and continuing education for health service employees should be stressed. One way is to bring in experts from the community and agencies.

11. There is growing concern that fewer young people choose careers in the health industry. By involving adolescents in health services and encouraging them to take responsibilities, more are likely to choose careers in health services.

Section III: Construction

Projected Number of Employees Needed in the Next 5 to 10 Years

How many construction industry employees will be needed in the next decade depends greatly on whether the United States experiences a depression or major recession. Typically, the industry replaces retiring employees or those choosing to leave the industry with 5 to 8 new entrants per generation. With a stable economy, the Department of Labor, Bureau of Labor Statistics, predicts a shortage of 2 million workers by the year 1990 and a shortage of 4.7 million by 1995.

Skill Requirements

The construction industry consists of 16 to 17 distinct crafts. While each of these crafts is escalating, electrical construction is rising the fastest. Masonry (brick and block laying) is also increasing in importance, as are trades related to the industrial manufacturers, such as instrumentation and millwright.

The construction industry lists occupational competencies required for jobs in V-TECS catalogues, all approved by occupational committees. For example, occupational competencies for electrical construction are identified by job analysis, task analysis, Dacom and process analysis.

Because of the advancement in technology, the construction industry will need higher trained individuals entering the job market. The old mentality of 'last resort' careers has to cease.

Frederick E. Powers, Director of Education
Associated Builders and Contractors, Inc.

Few changes in skill requirements are expected in the construction industry in the next 5 to 10 years; however, more training in microprocessors, telecommunications and digital electronics may be required.

Employees in the construction industry need skills in science and communication, plus good working knowledge of general math at a minimum of a 10th grade level. Some jobs may require competency in algebra, tri-solid and plane geometry, simulation equations and calculus. Reading skills are necessary to interpret blueprints and specifications.

Equipment

Construction employees need to use a variety of equipment, some generic to all trades and some specific to an occupation.

There is no difference in the type of equipment secondary and postsecondary students should be trained to use; however, most vocational education programs lack enough equipment to teach students all phases of the construction industry, from simple residential construction to advanced processes, motor control and commercial construction. There also is not enough time to cover all aspects of the numerous occupations within the construction industry.

Basic hand tool safety and use should be emphasized at the secondary and postsecondary levels. Theory (electrical, pneumatic and hydraulic) should be covered thoroughly, and students need a solid base in math and the physical sciences.

The construction industry trains its personnel through apprenticeship programs to use every type of equipment commonly used by the occupational trades in residential, commercial and industrial jobs. Employees are trained progressively on all contractor-owned tools and heavy equipment as they gain experience and prove their basic skills and knowledge of technology.

In the next 5 to 10 years, the industry will see increased use of advanced electronic and telecommunication equipment such as those in the so-called "smart house" and "intelligent building" construction and flexible automated factories. Workers will use more computer-aided equipment, laser cutting and leveling equipment. Use of lightweight blocks will be increased, and motors will be improved.

Competency-based instruction is a common link upon which the construction industry and vocational-technical education are building mutually beneficial partnerships.

John Heffner
Director, Manpower and Training Services
Associated General Contractors of America

Facilities

Vocational-technical teaching facilities need adequate space and enough tools of durable quality to allow students plenty of hands-on experience. Cooperative efforts within the community can help by providing practical on-the-job experience.

Methods and Procedures

For some aspects of the construction industry, many changes are anticipated in methods and procedures in the next 5 to 10 years, such as increased use of computer-aided machinery. Also, because of the severe worker shortage in many areas of the country, there probably will be more short-term or fast-track training programs. Other changes will relate to computers, microprocessors, company-owned communications, telephone and

telecommunication systems, advanced motors, processor control-flexible machine tools and robotics.

Industry-Developed Resources and Training Materials

The construction industry has developed competency-based, task-oriented training curriculums that are in use throughout the country. Newsletters, brochures on career options and videos for high school students are being used to attract young people to the career possibilities in the construction trades. Training materials for apprenticeship programs and journeyman skill improvement courses are developed by the different crafts.

Other Information That Would Be Helpful

Members of the working group expressed strong feelings that local apprenticeships and postsecondary schools collaborate with secondary school industrial arts and vocational education programs to allow for an easy transition from one program to another.

To help alleviate the shortage of young people entering the construction industry, school counselors, parents and teachers can make students aware of the opportunities available in the construction and manufacturing industry. One industry representative suggested that career awareness programs in elementary schools is an excellent way to begin awareness of the advantages of jobs in the construction industry.

Before you can make counselors, parents and teachers aware of the opportunities in the construction industry, you must educate school boards, superintendents and Departments of Education. Awareness programs must start at the top or priorities will continue to weigh toward white collar opportunities.

Frederick E. Powers, Director of Education
Associated Builders and Contractors, Inc.

Representatives from the industry expressed the opinion that too often schools and counselors are rated on the percentage of students placed in college. They urged that emphasis should be placed on successful careers after graduation. Another trade representative suggested that awareness programs should be started in the junior high and middle schools.

The Bureau of Apprenticeship and Training, located at 200 Constitution Ave., N.W., Room N 4649, Washington, D.C. 20210, (202) 535-0540, can provide further information on apprenticeship programs.

Additional Comments

Additional comments made by participants from the construction industry at the working group meeting included a suggestion that cooperative agreements among education, trade association, labor and business be developed. Such arrangements that involve construction industry employees in the vocational-technical school programs help provide links and

transition for students from school to work, and helps the industry reduce apprenticeship program attrition. Representatives of the industry cautioned that cooperative industry-educational programs should be formalized with written agreements so both entities know what is expected and allowed in the relationship. Needless to say, representatives from the construction industry firmly believe secondary vocational-technical programs are important to the construction industry.

Industry representatives also stressed that students must learn by doing; therefore, courses should be designed for hands-on skill development. At the same time, instruction should not be too specialized or too general. Students need to have well-rounded competencies and should receive some cross-training in the basic trades. This makes it essential that vocational-technical teachers have a range of competencies and industry experience including commercial construction skills.

The working group concluded with an emphasis on the vast opportunities in the construction industry, saying that construction is the easiest industry to enter and begin your own business.

In Summary, What Needs To Be Done

1. Students need basic skills to enter vocational-technical education in construction, including math, science, communication and reading.

2. Vocational-technical education facilities need the equipment to teach students all phases of the construction industry, from simple residential construction to advanced processes, motor control and commercial construction.

3. Emphasis in vocational-technical programs needs to be put on basic hand tool safety.

4. Vocational-technical facilities need adequate space and enough tools of durable quality to allow students plenty of hands-on experience. Cooperative efforts within the community can help by providing practical on-the-job experience.

5. More short-term, fast-track training programs and self-help instructional materials need developing.

6. Local apprenticeships and postsecondary schools need to collaborate with secondary school industrial arts and vocational-technical education programs to allow for an easy transition from one program to another.

7. Career awareness programs as early as elementary school are needed to make young people aware of possibilities in the construction industry. Representatives of the construction industry, school counselors, parents and teachers should explore career choices in construction.

8. By using cooperative agreements among education, trade associations, labor and business involving construction employees in the vocational-technical education

programs students are provided with links and transitions from school to work, and the industry reduces apprenticeship program attrition.

9. Formalized cooperative industry-educational programs with written agreements so both entities know what is expected and allowed in the relationship need to be pursued.

10. Courses need to be designed for hands-on skill development with well-rounded competencies and cross-training in the basic trades. This makes it essential that vocational-technical teachers have a range of competencies and industry experiences, including commercial construction skills.

In Summation

As diverse as the fields of health care, electronics and construction are, they face some common needs. All now or shortly will be faced with a shortage of qualified employees. All depend on quality vocational-technical education programs to provide qualified workers to the field. All to some degree use business/industry and education partnerships to provide students with on-the-job, hands-on training and insight into the various occupations within the field. All use specialized equipment that can be expensive to provide. All require students entering vocational-technical education training to have a good background and skills in math, science, verbal and written communications and reading.

In all industries employers are looking for employees with values in ethics, self-discipline, responsibility, decision making and interpersonal relations.

Certain common needs were voiced by members of all three industry working groups. Following is a brief summary of those recurring needs:

1. Recruit.

2. Begin career awareness programs early, as early as elementary school.

3. Develop more self-help, stimulating learning materials that encourage information retention.

4. Keep vocational-technical instructors informed of current industry trends by attending conferences, trade shows and association meetings. Involve industry in the training of vocational-technical instructors.

5. Develop cooperative business/industry and education programs. Define the programs with written agreements so each entity knows exactly what is expected, what the limits are and who is responsible to make it happen.

6. Correlate curricula between secondary and postsecondary programs to avoid duplication of material. Introduce basic skills early and reinforce them through hands-on training.

7. Provide vocational-technical facilities with adequate space, enough state-of-the-art equipment of durable quality, adequate resources and reference materials and teachers with current knowledge of the industry.

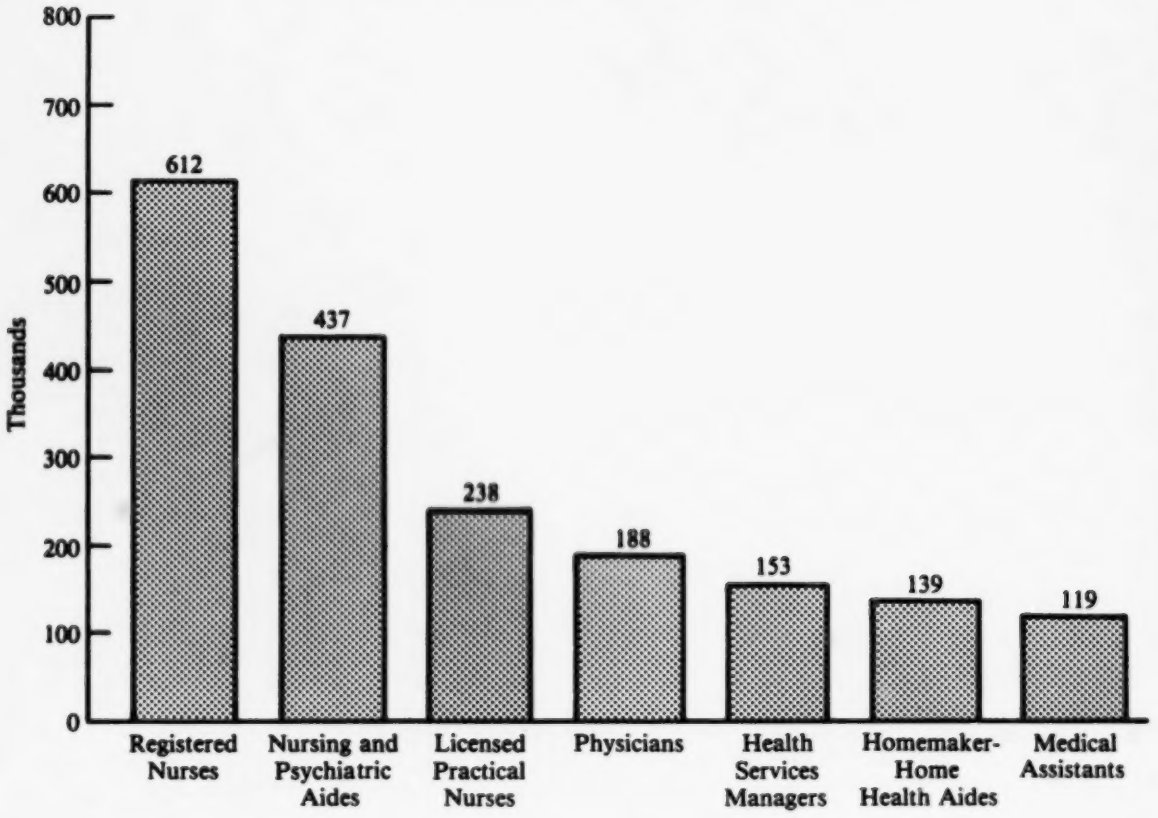
To remain competitive in world markets, American business and

industry must be productive and responsive to the demands of the market. To supply trained, skilled workers for business and industry, vocational-technical education programs must be responsive to the needs of business and industry. Through cooperation of all, those needs will be met.

Meetings like these working groups held under the auspices of the National Council on Vocational Education to explore the occupational competencies and needs of business and industry are the exact environment to spawn just such cooperation.

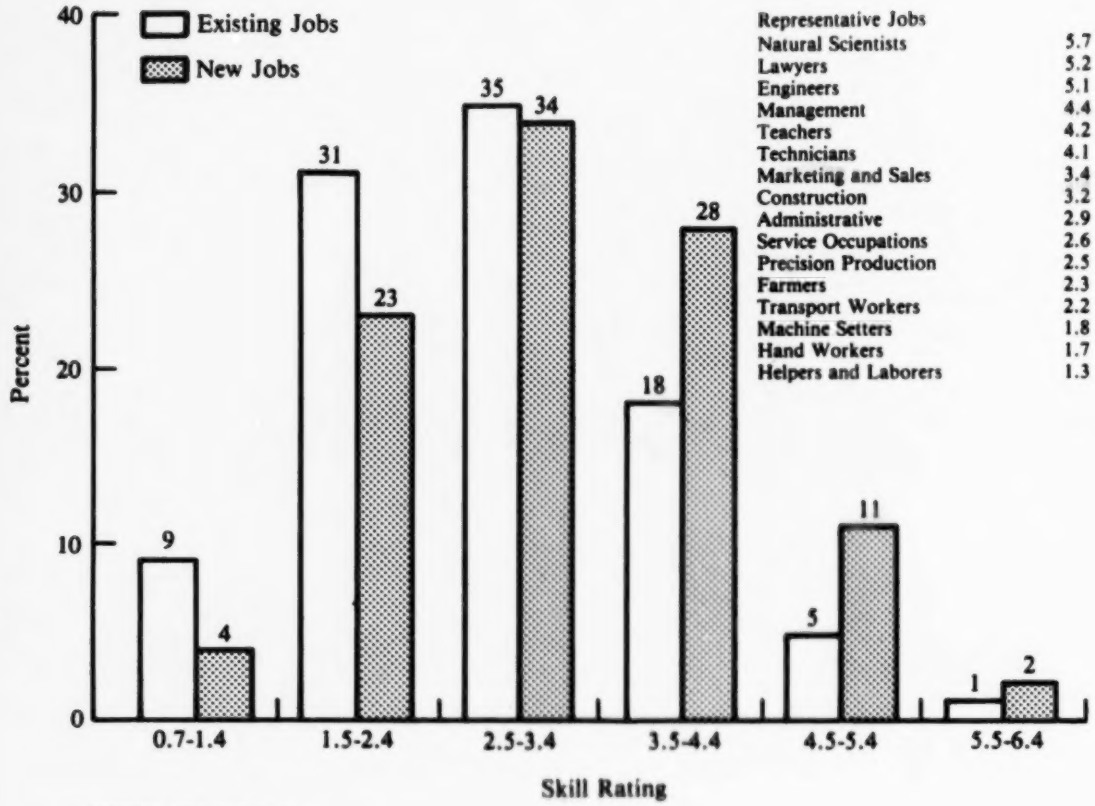
Appendix

Health Occupations With the Most New Jobs
1986-2000



SOURCE: Bureau of Labor Statistics

Low Skilled Jobs are Declining



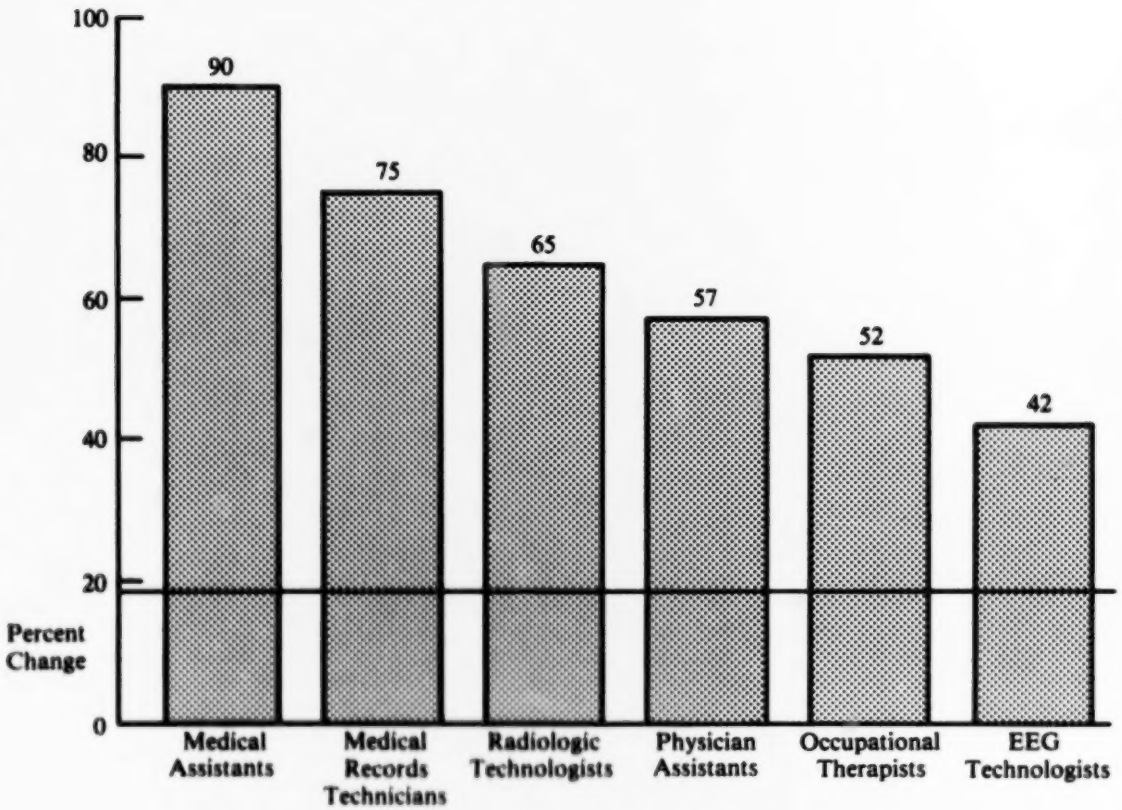
SOURCE: Hudson Institute.

The Occupations of the Future Will Require More Education

	Current Jobs	New Jobs
Total	100%	100%
8 Years or Less	6%	4%
1-3 Years of High School	12%	10%
4 Years of High School	40%	35%
1-3 years of College	20%	22%
4 Years of College or More	22%	30%
Median years of School	12.8	13.5

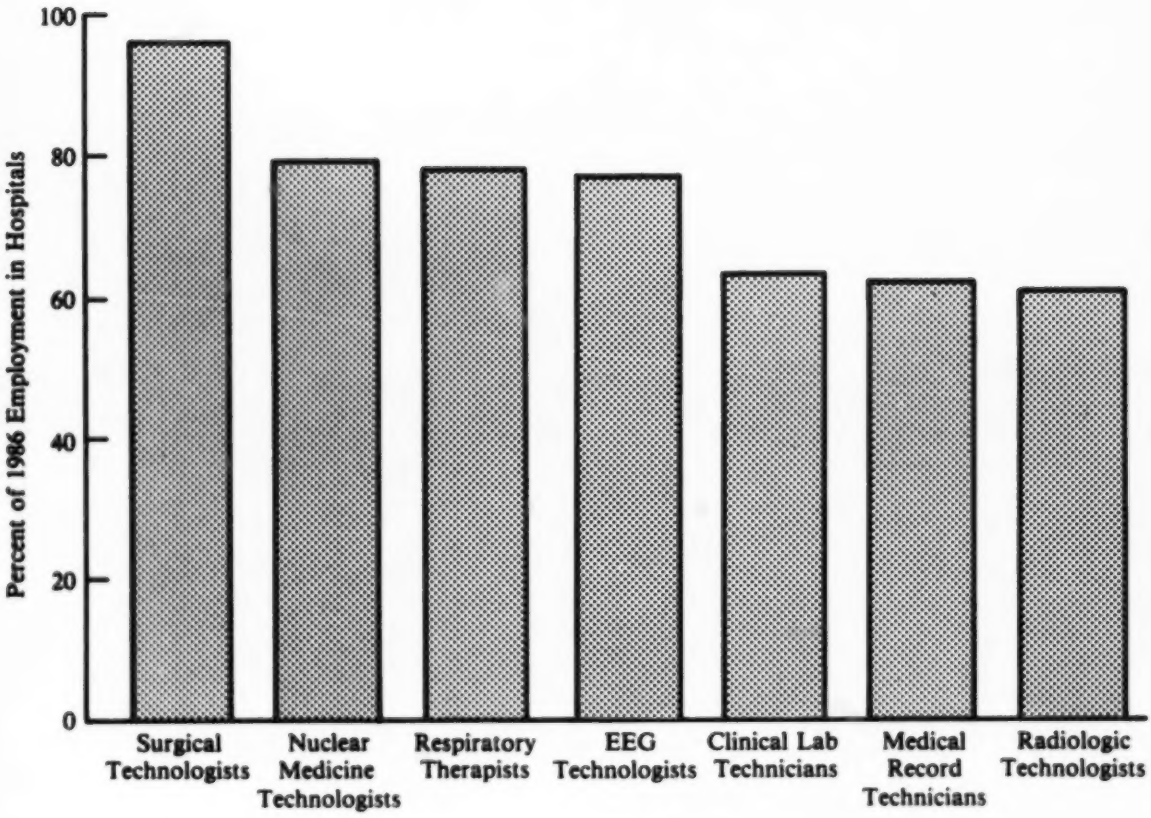
SOURCE: Bureau of Labor Statistics, Hudson Institute.

Most Health Occupations Will Grow Rapidly Through 2000



SOURCE: Bureau of Labor Statistics

Hospitals are the Major Source of Jobs in Many Allied Health Fields



SOURCE: Bureau of Labor Statistics

Health Industry Job Gains, 1972-2000

New Jobs in Thousands

	1972	1986-2000
Health Industry, Total	3,260	3,246
Hospitals	1,179	498
Nursing Homes	659	847
Physicians Offices	565	886
Dentists Offices	272	246
Other Practitioners Offices	140	257
Outpatient Facilities	198	227
Home Health Agencies	188	234
Medical and Dental Labs	59	51

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